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(54) Abstract Title
Optical disk and player and method for identifying disk type

(57) A BCA (Burst Cutting Area) code including a unique disk code indicating the type of a disk is written in a BCA code area of an optical disk. When the disk is mounted into the optical disk player, data written in the BCA code area is read and the type of the disk (e.g. CD, DVD, LD etc.) is determined by comparison of the extracted disk code and a disk code table.

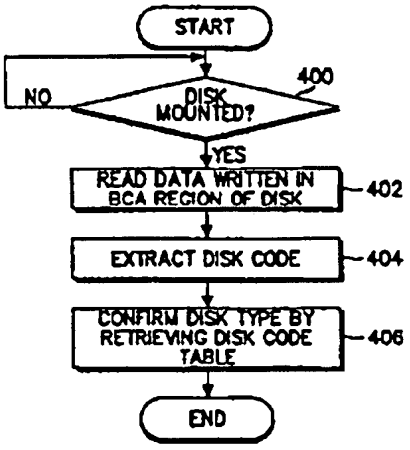

FIG. 4

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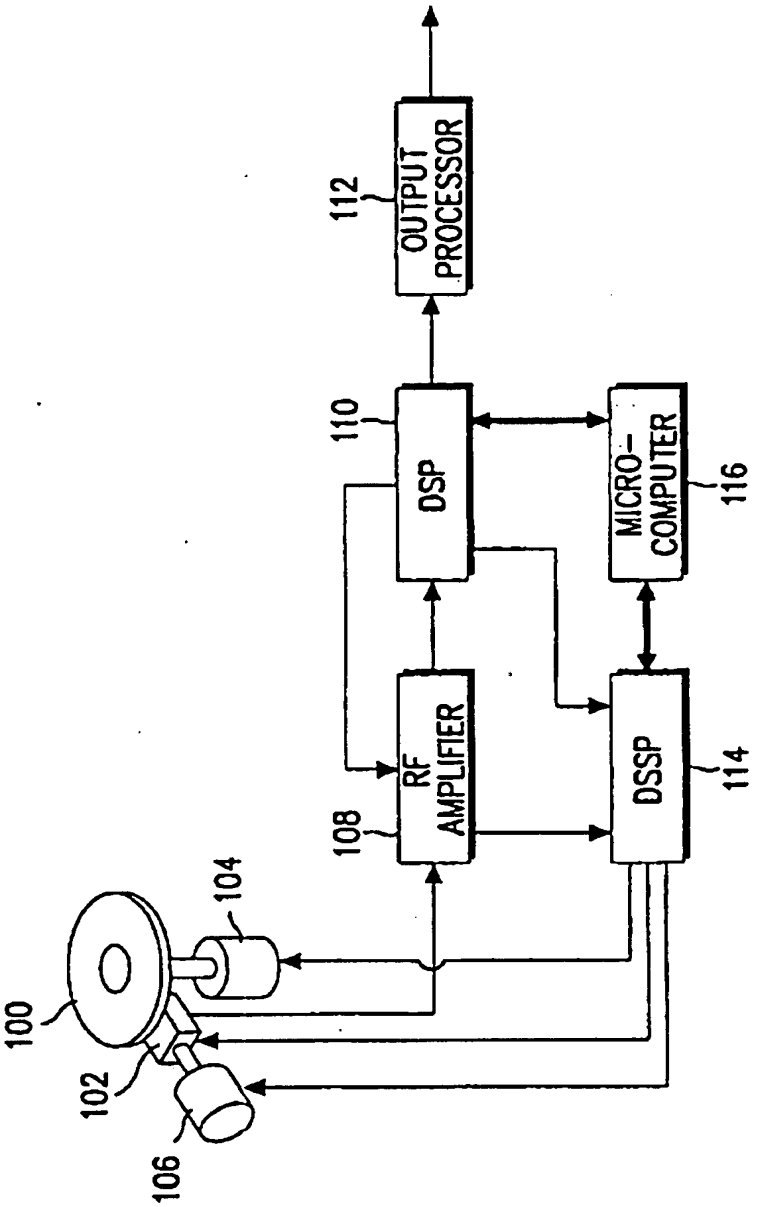
100
102
104
106
108
RF AMPLIFIER
110
DSP
112
OUTPUT PROCESSOR
114
DSSP
116
MICRO-COMPUTER

FIG. 1

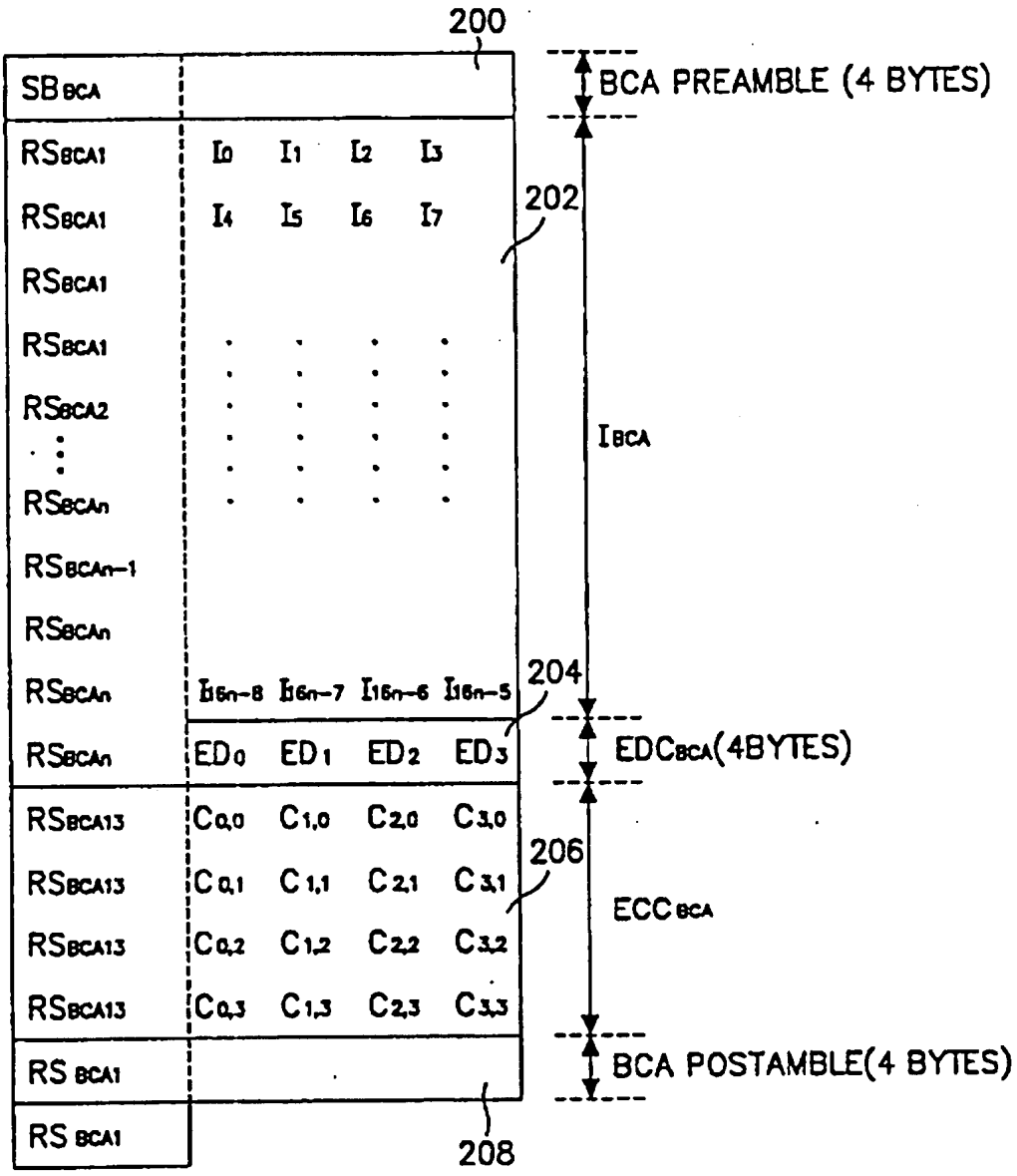
200
SB BCA
RS BCA1
RS BCA1
RS BCA1
RS BCA1
RS BCA2
RS BCAn
RS BCAn-1
RS BCAn
RS BCAn
RS BCAn
RS BCA13
RS BCA13
RS BCA13
RS BCA13
RS BCA1
RS BCA1
I0 I1 I2 I3
I4 I5 I6 I7
I16n-8 I16n-7 I16n-6 I16n-5
ED0 ED1 ED2 ED3
C0,0 C1,0 C2,0 C3,0
C0,1 C1,1 C2,1 C3,1
C0,2 C1,2 C2,2 C3,2
C0,3 C1,3 C2,3 C3,3
202
204
206
208
BCA PREAMBLE (4 BYTES)
IBCA
EDCBCA(4BYTES)
ECCBCA
BCA POSTAMBLE(4 BYTES)

FIG. 2

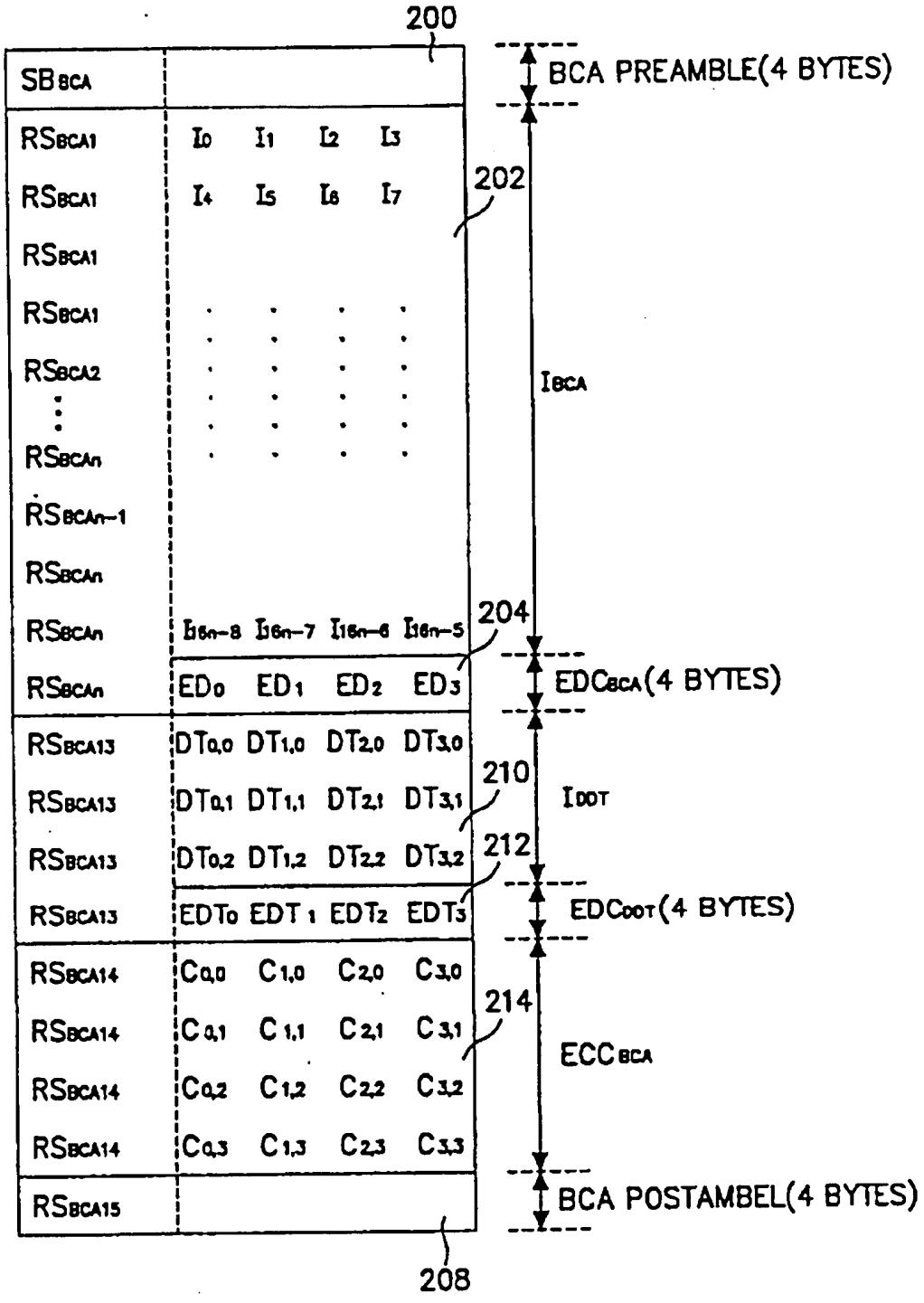
200
SB BCA
RS BCA1
RS BCA1
RS BCA1
RS BCA1
RS BCA2
RS BCAn
RS BCAn-1
RS BCAn
RS BCAn
RS BCAn
I0 I1 I2 I3
I4 I5 I6 I7
I16n-8 I16n-7 I16n-6 I16n-5
ED0 ED1 ED2 ED3
DT0,0 DT1,0 DT2,0 DT3,0
DT0,1 DT1,1 DT2,1 DT3,1
DT0,2 DT1,2 DT2,2 DT3,2
EDT0 EDT1 EDT2 EDT3
C0,0 C1,0 C2,0 C3,0
C0,1 C1,1 C2,1 C3,1
C0,2 C1,2 C2,2 C3,2
C0,3 C1,3 C2,3 C3,3
RS BCA15
208
202
204
210
212
214
BCA PREAMBLE(4 BYTES)
IBCA
EDCBCA(4 BYTES)
IDOT
EDCDOT(4 BYTES)
ECC BCA
BCA POSTAMBEL(4 BYTES)

FIG. 3

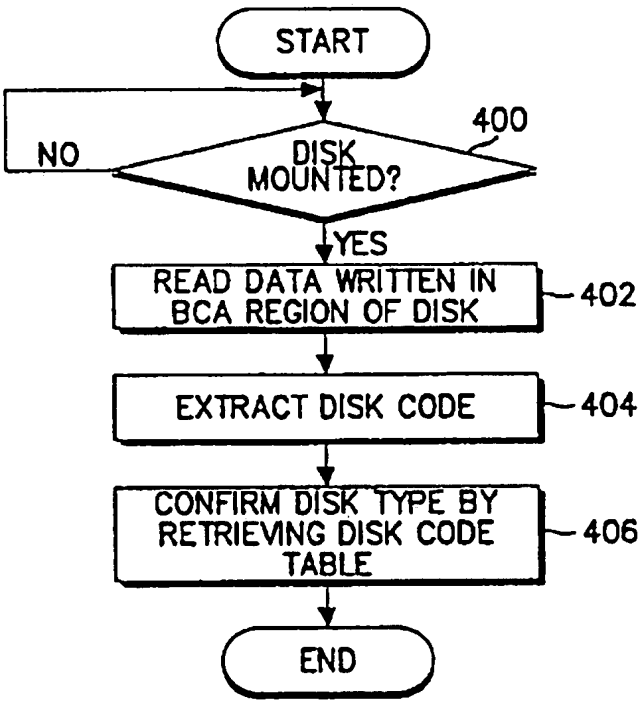
START
400
NO
DISK MOUNTED?
YES
READ DATA WRITTEN IN BCA REGION OF DISK
402
EXTRACT DISK CODE
404
CONFIRM DISK TYPE BY RETRIEVING DISK CODE TABLE
406
END

FIG. 4

OPTICAL DISK AND METHOD FOR IDENTIFYING DISK TYPE

The present invention relates to an optical disk player, and more particularly, to a method for discriminating the type of a disk mounted into an optical disk player.

An optical disk player is used to reproduce data recorded on an optical disk, such as a CD (Compact Disk), CD-ROM (Compact Disk-Read Only Memory), LD (Laser Disk), MD (Mini Disk), DVD (Digital Video Disk), etc. Since there are various types of optical disks, the optical disk player should discriminate the type of a disk mounted thereinto. Especially, a DVD player which uses a CD-series disk as well as a DVD-series disk may not accurately reproduce data unless it determines which type of disk is mounted.

A typical known method for discriminating the type of a disk used in a DVD player will now be described. If the user inserts the DVD-series or CD-series disk into the DVD player and a tray is closed, the DVD player sets its operating mode to a CD mode and starts focus searching. During the focus searching, the DVD player checks whether there is a focus error. If two focus error signals are respectively generated in the up and down movement directions of a lens, the DVD player judges the inserted disk to be a dual layer disk. If one focus error signal is generated, the inserted disk is regarded as a single layer disk. After the focusing step, the DVD player rotates a spindle motor and checks a phase difference between E and F signals detected by an E/F photo diode of an optical pickup. If the phase difference is 180°, the inserted disk is judged to be the CD-series disk, and if there is no phase difference, it is regarded as the DVD-series disk. Thereafter, the DVD player checks a lead-in area of the

disk to distinguish V-CD, a CD-audio from the CD-series disk, and DVD-single, DVD-dual from the DVD-series disk. Thus, the disk discriminating operation is completed. This operation is controlled by a microcomputer which is a main controller of the DVD player.

Since the above-described disk discriminating operation is performed step by step, the microcomputer passes through many steps for detecting the type of the disk. Therefore, the load on the microcomputer increases, and it takes a lot of time to discriminate the type of the disk, a waiting time until a normal playback state may be very long. Moreover, a check as to whether the disk is a dual layer or a single layer is made by using the focus error signal, and a determination as to whether the disk is the CD-series or the DVD-series is made from the phase difference between the E and F signals by utilizing the fact that a track pitch of the CD-series disk is different from that of the DVD-series disk. Therefore, if the disk has scratches, the disk player may wrongly detect the type of the disk. When considering future optical disks which will be put on the market, it becomes very difficult to discriminate the type of the disk and there is a strong possibility that the type of the disk is wrongly detected.

It is an aim of the various aspects of the present invention to provide a disk, an optical disk player and a method for enabling rapid and accurate discrimination of the disk type.

According to a first aspect of the present invention there is provided a disk for an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code is written, wherein said BCA code includes unique disk code for identifying the type of said disk.

Preferably, the BCA code area includes a preamble area in which a BCA preamble is written; an information data area in which BCA information data is written; an information parity area in which an error detection code for the BCA information data is written; a disk code area in which a unique disk code indicating the type of the disk is written; a disk code parity area in which an error detecting code for the disk code is written; an error correcting parity area in which an error correcting code for the BCA information data, for the error detecting code of the BCA information data, for the disk code and for the error detecting code of the disk code is written; and a postamble area in which a BCA postamble is written. Preferably, the BCA code area is arranged in the order of the preamble area, information data area, information parity area, disk code area, disk code parity area, error correcting parity area, and postamble area.

Preferably, the BCA code area is situated in the innermost area of a lead-in area on the disk and represents an area in which the BCA code is written. Although the BCA code has not been yet defined as being used for a specific purpose, it may be used as a disk ID (Identification). A parity for error detection is typically called an error detecting code (EDC) and a parity for error correction is called an error correcting code (ECC).

According to a second aspect of the present invention there is provided an optical disk player for receiving a disk as described herein, said optical disk player comprising: means for reading data written in said BCA code area upon mounting said disk into said optical disk player; means for extracting said unique disk code; and

means for determining the disk type corresponding to the extracted disk code.

Preferably, said determining means comprises means for retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

According to a further aspect of the present invention there is provided a method for discriminating the type of a disk in an optical disk player includes the steps of: reading data written in a BCA code area upon mounting the disk into the optical disk player; extracting a disk code contained in the read data; and confirming the type of the disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

Preferably, the disk code table is stored in a nonvolatile memory of the optical disk player by a manufacturer.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a block diagram of a general optical disk player;

Figure 2 shows a general BCA code structure;

Figure 3 shows a BCA code structure according to a preferred embodiment of the present invention; and

Figure 4 is a flow chart showing a disk discriminating process according to an embodiment of the present invention.

In the following description, numerous specific details, such as a BCA code structure, a processing flow, equations, and the like, are set forth to provide a more thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practised without these specific details. In other instances, well known functions or constructions have not been described so as not to obscure the present invention.

Referring to Figure 1, an optical pickup 102 optically picks up information recorded on a disk 100 and generates an electrically converted RF (radio frequency) signal. The optical pickup 102 has a focusing actuator and a tracking actuator. The focusing actuator is driven by the control of a DSSP (Digital Servo Signal Processor) 114 and shifts an object lens toward an optical axis. The tracking actuator shifts the object lens toward the radial direction of the disk 100 to seek a track. A spindle motor 104 is driven under the control of the DSSP 114 to rotate a disk 100 at a CLV (Constant Linear Velocity). A sled feed motor 106 is driven under the control of the DSSP 114 to move the optical pickup 102.

An RF amplifier 108 amplifies the RF signal received from the optical pickup 102 and shapes a waveform of the amplified RF signal. The RF amplifier 108 supplies a modulation signal during writing to a DSP (Digital Signal Processor) 110 and supplies signals for tracking servo and focusing servo to the DSSP 114. If the disk 100 is a CD-series disk, the modulation signal is an EFM (Eight to

Fourteen Modulation) signal. If the disk 100 is a DVD-series disk, the modulation signal is an EFM plus signal. The DSP 110 demodulates the signal received from the RF amplifier 108 and corrects an error for the demodulated signal to restore information data. In this case, the DSP 110 also restores a BCA (Burst Cutting Area) code reproduced from a BCA code area on the disk 100. An output processor 112 processes the data generated from the DSP 110 and generates a final output signal such as an audio signal. The DSSP 114 controlled by a microcomputer 116 controls tracking servo and focusing servo of the optical pickup 102, sled servo using the sled feed motor 106, and spindle servo, in response to signals received from the RF amplifier 108 and the DSP 110. The microcomputer 116, which is a main controller, controls the overall operation of an optical disk player.

Figure 2 illustrates a general BCA code structure. The BCA code comprises a BCA preamble 200, BCA information data I_{BCA} 202, an error detecting code EDC_{BCA} 204, an error correcting code ECC_{BCA} 206, and a BCA postamble 208. The BCA code is written in the disk together with a corresponding synchronizing byte. That is, the 4-byte BCA preamble 200 is written in the disk together with a BCA synchronizing byte SB_{BCA}. The BCA information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the error correcting code ECC_{BCA} 206, and the BCA postamble 208 are written in the disk together with a BCA re-synchronizing byte RS_{BCA}.

The BCA information data I_{BCA} 202 (I_0-I_{16n-5}) can be expressed by the following equation (1). The error detecting code EDC_{BCA} 204 (ED_0-ED_3) is a parity for detecting an error of the BCA information data I_{BCA} 202 and is expressed as the remainder obtained by dividing input data $I_{BCA}(x)$ by a polynomial $G(x)$.

$$I_{BCA}(x) = \sum_{i=32}^{128n-1} bi \cdot x^i \quad \text{.....(1)}$$

$$EDC_{BCA}(x) = \sum_{i=0}^{31} bi \cdot x^i \quad \text{.....(2)}$$

$$EDC_{BCA}(x) = I_{BCA}(x) \bmod G(x) \quad \text{.....(3)}$$

$$G(x) = x^{32} + x^{31} + x^4 + 1 \quad \text{.....(4)}$$

The error correcting code ECC_{BCA} 206 ($C_{0,0}$-$C_{3,3}$) is a parity for correcting errors of the BCD information data I_{BCA} 202 and the error detecting code EDC_{BCA} 204 and is expressed as the remainder obtained by dividing input data $I_{BCAj}(x)$ by a polynomial $G_{pBCA}(x)$ as shown in the following equations (5)-(9).

$$R_{BCAj}(x) = \sum_{i=0}^{3} C_{j,i} \cdot x^{3-i} \quad \text{.....(5)}$$

$$I_{BCAj}(x) = \sum_{i=0}^{4n-2} I_{j+4i} \cdot x^{51-i} + D_j \cdot x^{52-4n} \quad \text{.....(6)}$$

$$R_{BCAj}(x) = I_{BCAj}(x) \bmod G_{pBCA}(x) \quad \text{.....(7)}$$

$$G_{pBCA}(x) = \prod_{k=0}^{3} (X + a^k) \quad \text{.....(8)}$$

$$Gp(x) = x^8 + x^4 + x^3 + x^2 + 1 \quad \text{.....(9)}$$

On the other hand, as shown in the BCA code structure of Figure 2, there is a re-synchronizing byte RS_{BCA1} area which is not used in the BCA code area. That is, the BCA code is written in the BCA code area of a lead-in area on the disk and there is an unused re-synchronizing byte area in the BCA code area. Suitably, in the preferred embodiment of the present invention, the BCA code including a disk code is written on the disk. Therefore, the BCA code includes the disk code and the disk having the disk code in the BCA code area performs the normal operation in the optical disk player.

Figure 3 illustrates a BCA code structure according to an embodiment of the present invention. The BCA code shown in Figure 3 comprises a BCA preamble 200, BCA information data I_{BCA} 202, an error detecting code EDC_{BCA} 204, a disk code I_{DDT} 210, an error detecting code EDC_{DDT} 212, an error correcting code ECC_{BCA} 214, and a BCA postamble 208. In Figure 3, the BCA code includes the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 in addition to the BCD code shown in Figure 2, and the error correcting code ECC_{BCA} is modified. The BCA code is written in the disk together with a corresponding synchronizing byte. That is, the 4-byte BCA preamble 200 is written in the disk together with a BCA synchronizing byte SB_{BCA}. The BCA information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the disk code I_{DDT} 210, the error detecting code EDC_{DDT} 212, the error correcting code ECC_{BCA} 214, and the BCA postamble 208 are written in the disk together with a BCA re-synchronizing byte RS_{BCA}. Therefore, the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 are inserted into the BCA code, and the error correcting code ECC_{BCA} 214 and the BCA postamble 208 follow them. This is possible because the existing BCA code structure includes the unused re-synchronizing byte area.

The BCA information data I_{BCA} 202 (I_0-I_{16n-5}) is expressed by the above equation (1). The error detecting code EDC_{BCA} 204 (ED_0-ED_3) is a parity for detecting an error of the BCA information data I_{BCA} 202 and is expressed as the remainder obtained by dividing the BCA information data I_{BCA} 202 by the polynomial G(x) as indicated in the above equation (3).

The disk code I_{DDT} 210 indicating the type of the disk is expressed by the following equation (10). The 4-byte error detecting code EDC_{DDT} 212 is a parity for detecting an error of the disk code I_{DDT} 210 and can be expressed as the remainder obtained by dividing the disk code $I_{DDT}(x)$ by a polynomial G(x) as indicated in the following equation (12).

$$I_{DDT}(x) = \sum_{i=32}^{127n-1} di \cdot x^i \quad \ldots\ldots\ldots\ldots (10)$$

$$EDC_{DDT}(x) = \sum_{i=0}^{31} di \cdot x^i \quad \ldots\ldots\ldots (11)$$

$$EDC_{DDT}(x) = I_{DDT}(x) \bmod G(x) \quad \ldots\ldots (12)$$

$$G(x) = x^{32} + x^{31} + x^4 + 1 \quad \ldots\ldots\ldots (13)$$

The error correcting code ECC_{BCA} 214 ($C_{0,0}$-$C_{3,3}$) is a parity for correcting errors of the BCD information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 and can be expressed as the remainder obtained by dividing input data

$I_{BCAj}(x)$ by a polynomial $G_{pBCA}(x)$ as indicated in the following equation (16).

$$R_{BCAj}(x) = \sum_{i=0}^{3} C_{j,i} \cdot x^{3-i} \quad \text{.....(14)}$$

$$I_{BCAj}(x) = \sum_{i=0}^{4n-2} I_{j+4i} \cdot x^{55-i} + ED_j \cdot x^{55-4n} + \sum_{k=0}^{2} DT_{j,k} \cdot x^{7-k} + EDT_j \cdot x^4 \quad \text{.....(15)}$$

$$R_{BCAj}(x) = I_{BCAj}(x) \bmod G_{pBCA}(x) \quad \text{.....(16)}$$

$$G_{pBCA}(x) = \prod_{m=0}^{3} (X + a^m) \quad \text{.....(17)}$$

$$Gp(x) = x^8 + x^4 + x^3 + x^2 + 1 \quad \text{.....(18)}$$

The BCA code having the above-mentioned structure is sequentially written in the BCA code area on the disk. Therefore, the BCA code area in which the BCA code including the disk code is written has: a preamble area in which the BCA preamble is written; an information data area in which the BCA information data is written; an information parity area in which the error detection code for the BCA information data is written; a disk code area in which a unique disk code indicating the type of the disk is written; a disk code parity area in which the error detecting code for the disk code is written; an error correcting parity area in which the error correcting code for the BCA information data, for the error detecting code of the BCA information data, for the disk code and

for the error detecting code of the disk code is written; and a postamble area in which the BCA postamble is written. The BCA code area is arranged in the order of the preamble area, the information data area, the information parity area, the disk code area, the disk code parity area, the error correcting parity area, and the postamble area.

Figure 4 illustrates a disk discriminating process using the disk code when the disk in which the BCA code is written is mounted into the optical disk player. This process is performed by the microcomputer 116 shown in Figure 1. If the disk 100 having the BCA code area in which the BCA code of Figure 3 is written is mounted into the optical disk player of Figure 1 at step 400, the microcomputer 116 reads data written in the BCA code area on the disk 100 at step 402. The read data is restored by the DSP 110. The microcomputer 116 extracts the disk code contained in the read data through the DSP 110 at step 404. The microcomputer 116 confirms the type of the disk corresponding to the extracted disk code by retrieving a disk code table at step 406. The disk code table is provided from a manufacturer by previously mapping the disk codes corresponding to the types of disks and stored in a nonvolatile memory of the microcomputer 116.

Consequently, a unique disk code corresponding to the type of a disk is previously written in the disk and the type of the disk is discriminated by using the disk code. Therefore, the type of the disk mounted into the optical disk player can be rapidly and accurately detected. Since the disk code and its error detecting code are inserted into the re-synchronizing byte area which is not used in the existing BCA code structure, the added codes have no

effect on the existing BCA code and the inventive disk can perform the normal operation .

As mentioned above, the type of the disk mounted into the optical disk player can be rapidly and accurately detected by using the disk code contained in the BCA code.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and that it may be possible, for example, to modify the number of bytes of the BCA code or the disk code and to differently apply the polynomial or the parity.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly

stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A disk for an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code is written, wherein said BCA code includes unique disk code for identifying the type of said disk.

2. A disk as claimed in claim 1 wherein said BCA code area is situated in a lead-in area of said disk.

3. A disk as claimed in claim 1 or 2, wherein said BCA code area comprises:

a preamble area in which a BCA preamble is written;

an information data area in which BCA information data is written;

an information parity area in which an error detection code for said BCA information data is written;

a disk code area in which said unique disk code indicating the type of said disk is written;

a disk code parity area in which an error detecting code for said disk code is written;

an error correcting parity area in which an error correcting code for said BCA information data, for said error detecting code of said BCA information data, for said disk code and for said error detecting code of said disk code is written; and

a postamble area in which a BCA postamble is written.

4. A disk as claimed in claim 3, wherein said BCA code area is arranged in the order of said preamble area, information data area, information parity area, disk code area, disk code parity area, error correcting parity area, and postamble area.

5. An optical disk player for receiving a disk as claimed in any of claims 1 to 4, comprising:

means for reading data written in said BCA code area upon mounting said disk into said optical disk player;

means for extracting said unique disk code; and

means for determining the disk type corresponding to the extracted disk code.

6. An optical disk player as claimed in claim 5, wherein said determining means comprises means for retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

7. A method for discriminating the type of a disk in an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code including a unique disk code is written, said method comprising the steps of:

reading data written in said BCA code area upon mounting said disk into said optical disk player;

extracting the disk code contained in the read data; and

confirming the type of said disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

8. A method for discriminating the type of a disk used in an optical disk player, comprising the steps of:

writing a BCA (Burst Cutting Area) code including a unique disk code indicating the type of said disk in a BCA code area defined in a lead-in area of said disk;

reading data written in said BCA code area upon mounting said disk into said optical disk player;

extracting the disk code contained in the read data; and

confirming the type of said disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to types of disks are mapped.

9. The method as claimed in claim 8, wherein said writing step comprises the steps of:

writing a BCA preamble in a preamble area situated at the front of said BCA code area;

writing BCA information data in an information data area following said preamble area;

writing an error detection code for said BCA information data in an information parity area following said information data area;

writing a unique disk code indicating the type of said disk in a disk code area following said information parity area;

writing an error detecting code for said disk code in a disk code parity area following said disk code area;

writing an error correcting code for said BCA information data, for said error detecting code of said BCA information data, for said disk code and for said error detecting code of said disk code in an error correcting parity area following said disk code parity area; and

writing a BCA postamble in a postamble area following said error correcting parity area.

10. A disk substantially as hereinbefore described with reference to Figure 3 of the accompanying drawings.

11. An optical disk player substantially as hereinbefore described with reference to Figures 1, 3 and 4 of the accompanying drawings.

12. A method for discriminating the type of a disk in an optical disk player substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings.

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(56) Documents Cited
EP 0853315 A2 EP 0536764 A1 WO 98/58368 A1
US 5541905 A US 5428592 A US 4989195 A

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INT CL[6] G11B 7/12 11/10 19/12 20/00 23/36
Online: WPI, JAPIO

(54) Abstract Title
Optical disk and player and method for identifying disk type

(57) A BCA (Burst Cutting Area) code including a unique disk code indicating the type of a disk is written in a BCA code area of an optical disk. When the disk is mounted into the optical disk player, data written in the BCA code area is read and the type of the disk (e.g. CD, DVD, LD etc.) is determined by comparison of the extracted disk code and a disk code table.

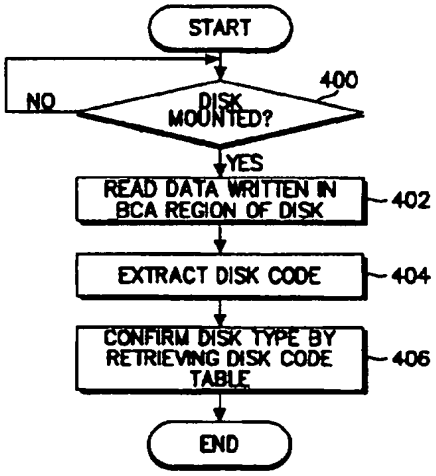

FIG. 4

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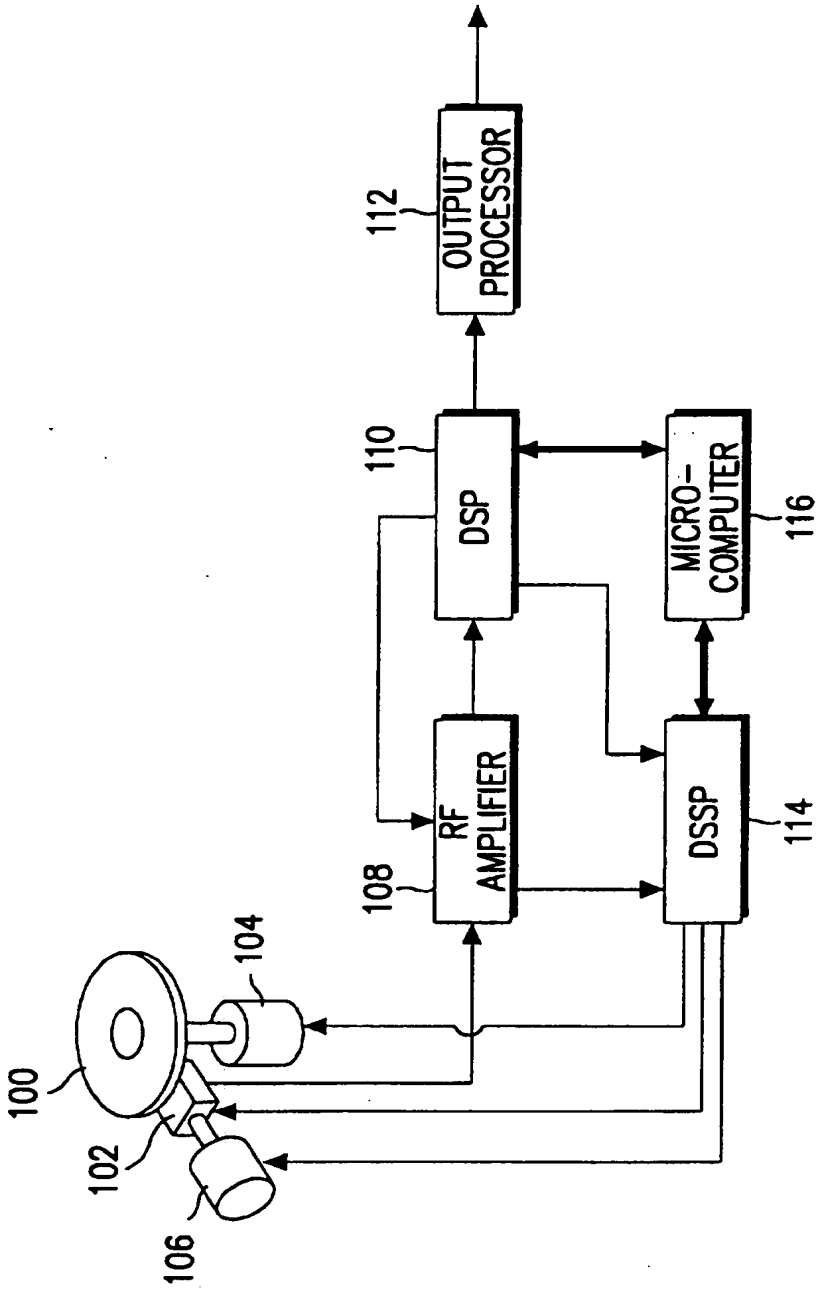
100
102
104
106
108
RF AMPLIFIER
110
DSP
112
OUTPUT PROCESSOR
114
DSSP
116
MICRO-COMPUTER

FIG. 1

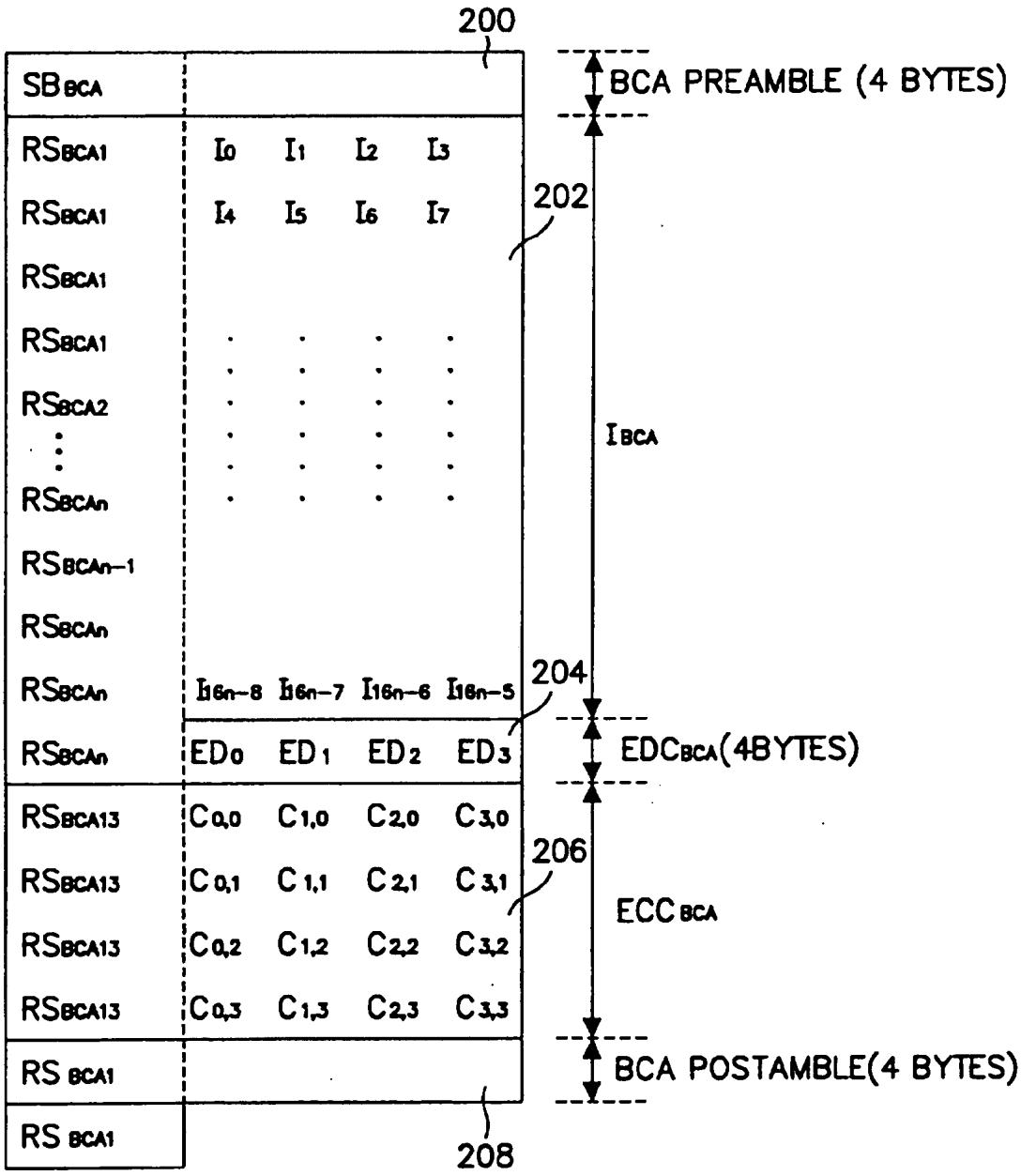
200
SB BCA
RS BCA1
RS BCA1
RS BCA1
RS BCA1
RS BCA2
RS BCAn
RS BCAn-1
RS BCAn
RS BCAn
RS BCAn
RS BCA13
RS BCA13
RS BCA13
RS BCA13
RS BCA1
RS BCA1
I0 I1 I2 I3
I4 I5 I6 I7
I16n-8 I16n-7 I16n-6 I16n-5
ED0 ED1 ED2 ED3
C0,0 C1,0 C2,0 C3,0
C0,1 C1,1 C2,1 C3,1
C0,2 C1,2 C2,2 C3,2
C0,3 C1,3 C2,3 C3,3
202
204
206
208
BCA PREAMBLE (4 BYTES)
IBCA
EDCBCA(4BYTES)
ECCBCA
BCA POSTAMBLE(4 BYTES)

FIG. 2

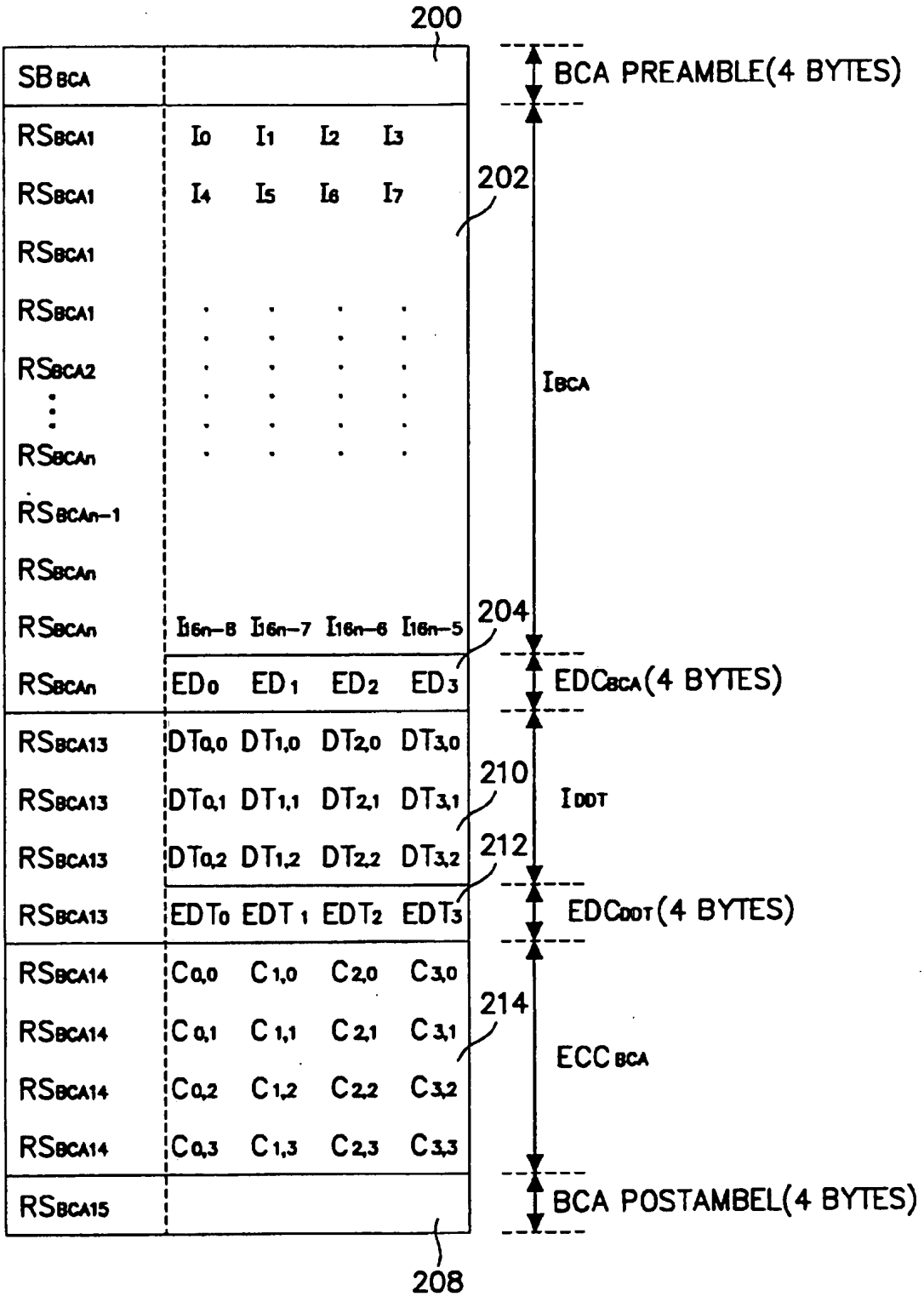
200
SBBCA
RSBCA1
RSBCA1
RSBCA1
RSBCA1
RSBCA2
RSBCAn
RSBCAn-1
RSBCAn
RSBCAn
RSBCAn
RSBCA13
RSBCA13
RSBCA13
RSBCA13
RSBCA14
RSBCA14
RSBCA14
RSBCA14
RSBCA15
I0 I1 I2 I3
I4 I5 I6 I7
I16n-8 I16n-7 I16n-6 I16n-5
ED0 ED1 ED2 ED3
DT0,0 DT1,0 DT2,0 DT3,0
DT0,1 DT1,1 DT2,1 DT3,1
DT0,2 DT1,2 DT2,2 DT3,2
EDT0 EDT1 EDT2 EDT3
C0,0 C1,0 C2,0 C3,0
C0,1 C1,1 C2,1 C3,1
C0,2 C1,2 C2,2 C3,2
C0,3 C1,3 C2,3 C3,3
202
204
210
212
214
208
BCA PREAMBLE(4 BYTES)
IBCA
EDCBCA(4 BYTES)
IDDT
EDCDDT(4 BYTES)
ECCBCA
BCA POSTAMBEL(4 BYTES)

FIG. 3

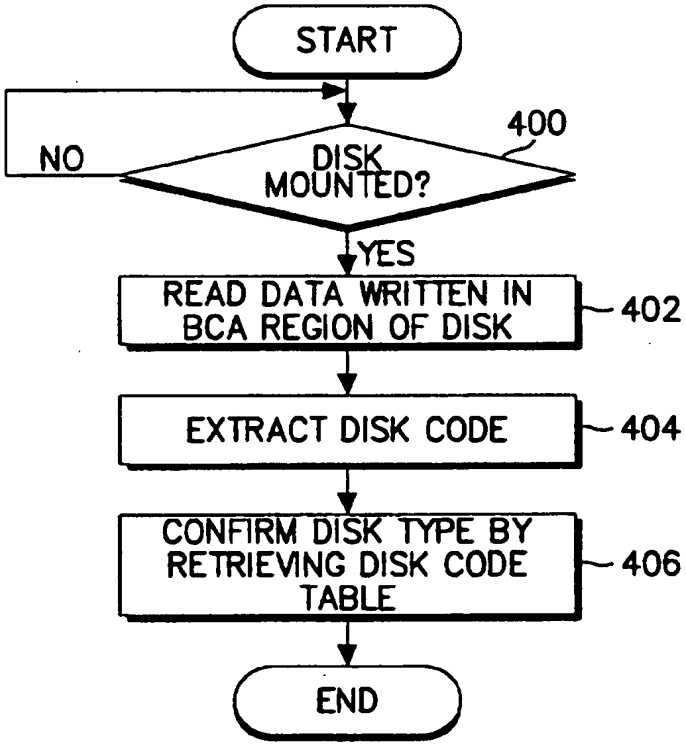
START
400
NO
DISK MOUNTED?
YES
READ DATA WRITTEN IN BCA REGION OF DISK
402
EXTRACT DISK CODE
404
CONFIRM DISK TYPE BY RETRIEVING DISK CODE TABLE
406
END

FIG. 4

OPTICAL DISK AND METHOD FOR IDENTIFYING DISK TYPE

The present invention relates to an optical disk player, and more particularly, to a method for discriminating the type of a disk mounted into an optical disk player.

An optical disk player is used to reproduce data recorded on an optical disk, such as a CD (Compact Disk), CD-ROM (Compact Disk-Read Only Memory), LD (Laser Disk), MD (Mini Disk), DVD (Digital Video Disk), etc. Since there are various types of optical disks, the optical disk player should discriminate the type of a disk mounted thereinto. Especially, a DVD player which uses a CD-series disk as well as a DVD-series disk may not accurately reproduce data unless it determines which type of disk is mounted.

A typical known method for discriminating the type of a disk used in a DVD player will now be described. If the user inserts the DVD-series or CD-series disk into the DVD player and a tray is closed, the DVD player sets its operating mode to a CD mode and starts focus searching. During the focus searching, the DVD player checks whether there is a focus error. If two focus error signals are respectively generated in the up and down movement directions of a lens, the DVD player judges the inserted disk to be a dual layer disk. If one focus error signal is generated, the inserted disk is regarded as a single layer disk. After the focusing step, the DVD player rotates a spindle motor and checks a phase difference between E and F signals detected by an E/F photo diode of an optical pickup. If the phase difference is 180°, the inserted disk is judged to be the CD-series disk, and if there is no phase difference, it is regarded as the DVD-series disk. Thereafter, the DVD player checks a lead-in area of the

disk to distinguish V-CD, a CD-audio from the CD-series disk, and DVD-single, DVD-dual from the DVD-series disk. Thus, the disk discriminating operation is completed. This operation is controlled by a microcomputer which is a main controller of the DVD player.

Since the above-described disk discriminating operation is performed step by step, the microcomputer passes through many steps for detecting the type of the disk. Therefore, the load on the microcomputer increases, and it takes a lot of time to discriminate the type of the disk, a waiting time until a normal playback state may be very long. Moreover, a check as to whether the disk is a dual layer or a single layer is made by using the focus error signal, and a determination as to whether the disk is the CD-series or the DVD-series is made from the phase difference between the E and F signals by utilizing the fact that a track pitch of the CD-series disk is different from that of the DVD-series disk. Therefore, if the disk has scratches, the disk player may wrongly detect the type of the disk. When considering future optical disks which will be put on the market, it becomes very difficult to discriminate the type of the disk and there is a strong possibility that the type of the disk is wrongly detected.

It is an aim of the various aspects of the present invention to provide a disk, an optical disk player and a method for enabling rapid and accurate discrimination of the disk type.

According to a first aspect of the present invention there is provided a disk for an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code is written, wherein said BCA code includes unique disk code for identifying the type of said disk.

Preferably, the BCA code area includes a preamble area in which a BCA preamble is written; an information data area in which BCA information data is written; an information parity area in which an error detection code for the BCA information data is written; a disk code area in which a unique disk code indicating the type of the disk is written; a disk code parity area in which an error detecting code for the disk code is written; an error correcting parity area in which an error correcting code for the BCA information data, for the error detecting code of the BCA information data, for the disk code and for the error detecting code of the disk code is written; and a postamble area in which a BCA postamble is written. Preferably, the BCA code area is arranged in the order of the preamble area, information data area, information parity area, disk code area, disk code parity area, error correcting parity area, and postamble area.

Preferably, the BCA code area is situated in the innermost area of a lead-in area on the disk and represents an area in which the BCA code is written. Although the BCA code has not been yet defined as being used for a specific purpose, it may be used as a disk ID (Identification). A parity for error detection is typically called an error detecting code (EDC) and a parity for error correction is called an error correcting code (ECC).

According to a second aspect of the present invention there is provided an optical disk player for receiving a disk as described herein, said optical disk player comprising: means for reading data written in said BCA code area upon mounting said disk into said optical disk player; means for extracting said unique disk code; and

means for determining the disk type corresponding to the extracted disk code.

Preferably, said determining means comprises means for retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

According to a further aspect of the present invention there is provided a method for discriminating the type of a disk in an optical disk player includes the steps of: reading data written in a BCA code area upon mounting the disk into the optical disk player; extracting a disk code contained in the read data; and confirming the type of the disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

Preferably, the disk code table is stored in a nonvolatile memory of the optical disk player by a manufacturer.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a block diagram of a general optical disk player;

Figure 2 shows a general BCA code structure;

Figure 3 shows a BCA code structure according to a preferred embodiment of the present invention; and

Figure 4 is a flow chart showing a disk discriminating process according to an embodiment of the present invention.

In the following description, numerous specific details, such as a BCA code structure, a processing flow, equations, and the like, are set forth to provide a more thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practised without these specific details. In other instances, well known functions or constructions have not been described so as not to obscure the present invention.

Referring to Figure 1, an optical pickup 102 optically picks up information recorded on a disk 100 and generates an electrically converted RF (radio frequency) signal. The optical pickup 102 has a focusing actuator and a tracking actuator. The focusing actuator is driven by the control of a DSSP (Digital Servo Signal Processor) 114 and shifts an object lens toward an optical axis. The tracking actuator shifts the object lens toward the radial direction of the disk 100 to seek a track. A spindle motor 104 is driven under the control of the DSSP 114 to rotate a disk 100 at a CLV (Constant Linear Velocity). A sled feed motor 106 is driven under the control of the DSSP 114 to move the optical pickup 102.

An RF amplifier 108 amplifies the RF signal received from the optical pickup 102 and shapes a waveform of the amplified RF signal. The RF amplifier 108 supplies a modulation signal during writing to a DSP (Digital Signal Processor) 110 and supplies signals for tracking servo and focusing servo to the DSSP 114. If the disk 100 is a CD-series disk, the modulation signal is an EFM (Eight to

Fourteen Modulation) signal. If the disk 100 is a DVD-series disk, the modulation signal is an EFM plus signal. The DSP 110 demodulates the signal received from the RF amplifier 108 and corrects an error for the demodulated signal to restore information data. In this case, the DSP 110 also restores a BCA (Burst Cutting Area) code reproduced from a BCA code area on the disk 100. An output processor 112 processes the data generated from the DSP 110 and generates a final output signal such as an audio signal. The DSSP 114 controlled by a microcomputer 116 controls tracking servo and focusing servo of the optical pickup 102, sled servo using the sled feed motor 106, and spindle servo, in response to signals received from the RF amplifier 108 and the DSP 110. The microcomputer 116, which is a main controller, controls the overall operation of an optical disk player.

Figure 2 illustrates a general BCA code structure. The BCA code comprises a BCA preamble 200, BCA information data I_{BCA} 202, an error detecting code EDC_{BCA} 204, an error correcting code ECC_{BCA} 206, and a BCA postamble 208. The BCA code is written in the disk together with a corresponding synchronizing byte. That is, the 4-byte BCA preamble 200 is written in the disk together with a BCA synchronizing byte SB_{BCA}. The BCA information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the error correcting code ECC_{BCA} 206, and the BCA postamble 208 are written in the disk together with a BCA re-synchronizing byte RS_{BCA}.

The BCA information data I_{BCA} 202 (I_0-I_{16n-5}) can be expressed by the following equation (1). The error detecting code EDC_{BCA} 204 (ED_0-ED_3) is a parity for detecting an error of the BCA information data I_{BCA} 202 and is expressed as the remainder obtained by dividing input data $I_{BCA}(x)$ by a polynomial $G(x)$.

$$I_{BCA}(x) = \sum_{i=32}^{128n-1} bi \cdot x^i \quad \text{.....(1)}$$

$$EDC_{BCA}(x) = \sum_{i=0}^{31} bi \cdot x^i \quad \text{.....(2)}$$

$$EDC_{BCA}(x) = I_{BCA}(x) \bmod G(x) \quad \text{.....(3)}$$

$$G(x) = x^{32} + x^{31} + x^4 + 1 \quad \text{.....(4)}$$

The error correcting code ECC_{BCA} 206 ($C_{0,0}$-$C_{3,3}$) is a parity for correcting errors of the BCD information data I_{BCA} 202 and the error detecting code EDC_{BCA} 204 and is expressed as the remainder obtained by dividing input data $I_{BCAj}(x)$ by a polynomial $G_{pBCA}(x)$ as shown in the following equations (5)-(9).

$$R_{BCAj}(x) = \sum_{i=0}^{3} C_{j,i} \cdot x^{3-i} \quad \text{.....(5)}$$

$$I_{BCAj}(x) = \sum_{i=0}^{4n-2} I_{j+4i} \cdot x^{51-i} + D_j \cdot x^{52-4n} \quad \text{.....(6)}$$

$$R_{BCAj}(x) = I_{BCAj}(x) \bmod G_{pBCA}(x) \quad \text{.....(7)}$$

$$G_{pBCA}(x) = \prod_{k=0}^{3} (X + a^k) \quad \text{.....(8)}$$

$$\mathbf{Gp(x) = x^8 + x^4 + x^3 + x^2 + 1} \quad \text{.....(9)}$$

On the other hand, as shown in the BCA code structure of Figure 2, there is a re-synchronizing byte RS_{BCA1} area which is not used in the BCA code area. That is, the BCA code is written in the BCA code area of a lead-in area on the disk and there is an unused re-synchronizing byte area in the BCA code area. Suitably, in the preferred embodiment of the present invention, the BCA code including a disk code is written on the disk. Therefore, the BCA code includes the disk code and the disk having the disk code in the BCA code area performs the normal operation in the optical disk player.

Figure 3 illustrates a BCA code structure according to an embodiment of the present invention. The BCA code shown in Figure 3 comprises a BCA preamble 200, BCA information data I_{BCA} 202, an error detecting code EDC_{BCA} 204, a disk code I_{DDT} 210, an error detecting code EDC_{DDT} 212, an error correcting code ECC_{BCA} 214, and a BCA postamble 208. In Figure 3, the BCA code includes the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 in addition to the BCD code shown in Figure 2, and the error correcting code ECC_{BCA} is modified. The BCA code is written in the disk together with a corresponding synchronizing byte. That is, the 4-byte BCA preamble 200 is written in the disk together with a BCA synchronizing byte SB_{BCA}. The BCA information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the disk code I_{DDT} 210, the error detecting code EDC_{DDT} 212, the error correcting code ECC_{BCA} 214, and the BCA postamble 208 are written in the disk together with a BCA re-synchronizing byte RS_{BCA}. Therefore, the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 are inserted into the BCA code, and the error correcting code ECC_{BCA} 214 and the BCA postamble 208 follow them. This is possible because the existing BCA code structure includes the unused re-synchronizing byte area.

The BCA information data I_{BCA} 202 (I_0-I_{16n-5}) is expressed by the above equation (1). The error detecting code EDC_{BCA} 204 (ED_0-ED_3) is a parity for detecting an error of the BCA information data I_{BCA} 202 and is expressed as the remainder obtained by dividing the BCA information data I_{BCA} 202 by the polynomial G(x) as indicated in the above equation (3).

The disk code I_{DDT} 210 indicating the type of the disk is expressed by the following equation (10). The 4-byte error detecting code EDC_{DDT} 212 is a parity for detecting an error of the disk code I_{DDT} 210 and can be expressed as the remainder obtained by dividing the disk code $I_{DDT}(x)$ by a polynomial G(x) as indicated in the following equation (12).

$$I_{DDT}(x) = \sum_{i=32}^{127n-1} di \cdot x^i \quad \ldots\ldots\ldots\ldots (10)$$

$$EDC_{DDT}(x) = \sum_{i=0}^{31} di \cdot x^i \quad \ldots\ldots\ldots (11)$$

$$EDC_{DDT}(x) = I_{DDT}(x) \bmod G(x) \quad \ldots\ldots (12)$$

$$G(x) = x^{32} + x^{31} + x^4 + 1 \quad \ldots\ldots\ldots (13)$$

The error correcting code ECC_{BCA} 214 ($C_{0,0}$-$C_{3,3}$) is a parity for correcting errors of the BCD information data I_{BCA} 202, the error detecting code EDC_{BCA} 204, the disk code I_{DDT} 210 and the error detecting code EDC_{DDT} 212 and can be expressed as the remainder obtained by dividing input data

$I_{BCAj}(x)$ by a polynomial $G_{pBCA}(x)$ as indicated in the following equation (16).

$$R_{BCAj}(x) = \sum_{i=0}^{3} C_{j,i} \cdot x^{3-i} \quad \text{.....(14)}$$

$$I_{BCAj}(x) = \sum_{i=0}^{4n-2} I_{j+4i} \cdot x^{55-i} + ED_j \cdot x^{56-4n} + \sum_{k=0}^{2} DT_{j,k} \cdot x^{7-k} + EDT_j \cdot x^4 \quad \text{.....(15)}$$

$$R_{BCAj}(x) = I_{BCAj}(x) \bmod G_{pBCA}(x) \quad \text{.....(16)}$$

$$G_{pBCA}(x) = \prod_{m=0}^{3} (X + a^m) \quad \text{.....(17)}$$

$$Gp(x) = x^8 + x^4 + x^3 + x^2 + 1 \quad \text{.....(18)}$$

The BCA code having the above-mentioned structure is sequentially written in the BCA code area on the disk. Therefore, the BCA code area in which the BCA code including the disk code is written has: a preamble area in which the BCA preamble is written; an information data area in which the BCA information data is written; an information parity area in which the error detection code for the BCA information data is written; a disk code area in which a unique disk code indicating the type of the disk is written; a disk code parity area in which the error detecting code for the disk code is written; an error correcting parity area in which the error correcting code for the BCA information data, for the error detecting code of the BCA information data, for the disk code and

for the error detecting code of the disk code is written; and a postamble area in which the BCA postamble is written. The BCA code area is arranged in the order of the preamble area, the information data area, the information parity area, the disk code area, the disk code parity area, the error correcting parity area, and the postamble area.

Figure 4 illustrates a disk discriminating process using the disk code when the disk in which the BCA code is written is mounted into the optical disk player. This process is performed by the microcomputer 116 shown in Figure 1. If the disk 100 having the BCA code area in which the BCA code of Figure 3 is written is mounted into the optical disk player of Figure 1 at step 400, the microcomputer 116 reads data written in the BCA code area on the disk 100 at step 402. The read data is restored by the DSP 110. The microcomputer 116 extracts the disk code contained in the read data through the DSP 110 at step 404. The microcomputer 116 confirms the type of the disk corresponding to the extracted disk code by retrieving a disk code table at step 406. The disk code table is provided from a manufacturer by previously mapping the disk codes corresponding to the types of disks and stored in a nonvolatile memory of the microcomputer 116.

Consequently, a unique disk code corresponding to the type of a disk is previously written in the disk and the type of the disk is discriminated by using the disk code. Therefore, the type of the disk mounted into the optical disk player can be rapidly and accurately detected. Since the disk code and its error detecting code are inserted into the re-synchronizing byte area which is not used in the existing BCA code structure, the added codes have no

effect on the existing BCA code and the inventive disk can perform the normal operation .

As mentioned above, the type of the disk mounted into the optical disk player can be rapidly and accurately detected by using the disk code contained in the BCA code.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and that it may be possible, for example, to modify the number of bytes of the BCA code or the disk code and to differently apply the polynomial or the parity.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly

stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A disk for an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code is written, wherein said BCA code includes unique disk code for identifying the type of said disk.

2. A disk as claimed in claim 1 wherein said BCA code area is situated in a lead-in area of said disk.

3. A disk as claimed in claim 1 or 2, wherein said BCA code area comprises:

a preamble area in which a BCA preamble is written;

an information data area in which BCA information data is written;

an information parity area in which an error detection code for said BCA information data is written;

a disk code area in which said unique disk code indicating the type of said disk is written;

a disk code parity area in which an error detecting code for said disk code is written;

an error correcting parity area in which an error correcting code for said BCA information data, for said error detecting code of said BCA information data, for said disk code and for said error detecting code of said disk code is written; and

a postamble area in which a BCA postamble is written.

4. A disk as claimed in claim 3, wherein said BCA code area is arranged in the order of said preamble area, information data area, information parity area, disk code area, disk code parity area, error correcting parity area, and postamble area.

5. An optical disk player for receiving a disk as claimed in any of claims 1 to 4, comprising:

means for reading data written in said BCA code area upon mounting said disk into said optical disk player;

means for extracting said unique disk code; and

means for determining the disk type corresponding to the extracted disk code.

6. An optical disk player as claimed in claim 5, wherein said determining means comprises means for retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

7. A method for discriminating the type of a disk in an optical disk player, said disk having a BCA (Burst Cutting Area) code area in which a BCA code including a unique disk code is written, said method comprising the steps of:

reading data written in said BCA code area upon mounting said disk into said optical disk player;

extracting the disk code contained in the read data; and

confirming the type of said disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to the types of disks are mapped.

8. A method for discriminating the type of a disk used in an optical disk player, comprising the steps of:

writing a BCA (Burst Cutting Area) code including a unique disk code indicating the type of said disk in a BCA code area defined in a lead-in area of said disk;

reading data written in said BCA code area upon mounting said disk into said optical disk player;

extracting the disk code contained in the read data; and

confirming the type of said disk corresponding to the extracted disk code by retrieving a disk code table in which disk codes corresponding to types of disks are mapped.

9. The method as claimed in claim 8, wherein said writing step comprises the steps of:

writing a BCA preamble in a preamble area situated at the front of said BCA code area;

writing BCA information data in an information data area following said preamble area;

writing an error detection code for said BCA information data in an information parity area following said information data area;

writing a unique disk code indicating the type of said disk in a disk code area following said information parity area;

writing an error detecting code for said disk code in a disk code parity area following said disk code area;

writing an error correcting code for said BCA information data, for said error detecting code of said BCA information data, for said disk code and for said error detecting code of said disk code in an error correcting parity area following said disk code parity area; and

writing a BCA postamble in a postamble area following said error correcting parity area.

10. A disk substantially as hereinbefore described with reference to Figure 3 of the accompanying drawings.

11. An optical disk player substantially as hereinbefore described with reference to Figures 1, 3 and 4 of the accompanying drawings.

12. A method for discriminating the type of a disk in an optical disk player substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings.

The Patent Office

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INVESTOR IN PEOPLE

Application No: GB 9828128.0 **Examiner:** Anna Mackisack
Claims searched: 1 - 12 **Date of search:** 30 March 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): G5R (RHC RHD RLFX)

Int Cl (Ed.6): G11B 7/12 11/10 19/12 20/00 23/36

Other: Online; WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, P	EP 0853315 A2	(VICTOR COMPANY OF JAPAN LTD) - see abstract	1, 7
X	EP 0536764 A1	(SONY CORPORATION) - see especially col. 5 lines 26 to 30	1, 2, 7
X, E	WO 98/58368 A1	(THOMSON CONSUMER ELECTRONICS) - see fig. 2	1, 2, 7
X	US 5541905 A	(ARAMAKI)	7
X	US 5428592 A	(ENDO) - col. 1 final paragraph	7
X	US 4989195 A	(SUZUKI) - see abstract	7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.